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Department of
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Federal
Grain
Inspection
Service

USDA Grain Storage, Handling and Processing Safety Coordinating Subcommittee

Annual Report, Fiscal Year 1989

USDA GRAIN STORAGE, HANDLING, AND PROCESSING SAFETY COORDINATING SUBCOMMITTEE

ANNUAL REPORT

FISCAL YEAR 1989

W. Kirk Miller

W. KIRK MILLER
Chairman

Les Malone

LES MALONE
Executive Secretary

U.S. Department of Agriculture

Grain Storage, Handling, and Processing

Safety Coordinating Subcommittee

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Mention of commercial organizations in this publication is solely to provide specific information. It does not constitute endorsement by the U.S. Department of Agriculture over other organizations not mentioned.

February 1990

SUMMARY

Fires and explosions in the grain-handling system are a major concern to the grain industry. The U.S. Department of Agriculture shares this concern and maintains an integrated grain elevator safety program in the Department. In 1982, the Secretary of Agriculture, John R. Block, established the USDA Grain Storage, Handling, and Processing Safety Coordinating Subcommittee to provide Departmental leadership and coordination for promoting safety in the efficient movement of grain from the farm to the domestic and export markets. This effort continues under Secretary of Agriculture Clayton Yeutter.

In addition to maintaining liaison and coordination with other governmental units and private sector groups, the USDA grain elevator safety program conducts scientific research on grain dust, maintains a data base on reported explosions in grain-handling facilities, operates a grain dust information center, and carries on continuing education and technology transfer to the grain industry.

During the past several years, other governmental and private sector groups have demonstrated leadership by developing aggressive programs in engineering and new technology, research, and education, as well as enforcement efforts to enhance worker safety and health in grain-handling facilities.

USDA GRAIN ELEVATOR SAFETY PROGRAM

This report was compiled in compliance with Departmental Regulation 1043-21, entitled "Grain Storage, Handling, and Processing Safety Program." The departmental regulation establishes a Safety Coordinating Subcommittee which reports to the Administration Committee of the Secretary's Policy and Coordination Council.

The Safety Coordinating Subcommittee is chaired by the Federal Grain Inspection Service (FGIS) Administrator. Other members of the subcommittee include agency administrators from the Agricultural Research Service (ARS), the Extension Service (ES), the Agricultural Stabilization and Conservation Service (ASCS), and the National Agricultural Library (NAL). The mission of the Safety Coordinating Subcommittee is to promote safety in grain-handling facilities by providing leadership and coordination in conjunction with other governmental and private sector groups. Specifically, the USDA Grain Elevator Safety Program was designed to undertake and accomplish specific safety initiatives within its legislative authority and existing levels of resources. The safety initiatives were identified by the Safety Coordinating Subcommittee and coordinated with industry and other governmental agencies with responsibility for safety in grain-handling operations.

The USDA Grain Elevator Safety Program policy areas include:

- Protection of USDA employees working in grain-handling facilities.
- Safety promotion.
- Research and education.
- Collection, analysis, and dissemination of information.

In carrying out the Grain Elevator Safety Program initiatives, FGIS maintains a central reporting, tracking, and monitoring system of explosion incidents in grain-handling facilities. To maintain an accurate data base, FGIS coordinates with representatives from Kansas State University, as well as the National Fire Protection Association and other groups on reported explosion incidents. Upon FGIS cross-validation of explosion information received by the Department, subsequent information is forwarded to the Occupational Safety and Health Administration (OSHA), Food and Drug Administration (FDA), and Environmental Protection Agency (EPA).

The ES safety initiative includes coordination, development, and dissemination of information, technology transfer, and other educational programs and materials under the auspices of the Cooperative Extension Service (CES) land-grant universities. CES conducts special safety training programs in coordination with industry and State trade associations for both employees and management. CES, union, industry, and trade association programs have enabled vital safety information to reach the grassroots levels. The National Institute for Occupational Safety and Health (NIOSH) provided special funding to ES to develop safety programs for small grain-handling facilities as well as the farmstead.

The NAL has developed a grain dust safety information center which serves as a valuable resource both at the national and international level. Secretary Yeutter placed a high priority on the importance of scientific and technical information being readily available to assist the agricultural community worldwide.

The ARS Grain Marketing Research Laboratory (USGMRL) located in Manhattan, Kansas, serves as the lead agency for research on grain dust safety for the Department. The USGMRL has undertaken or completed various studies to date in this area. The USGMRL coordinates many of its research studies with industry and other scientific groups. Several research projects have been completed and final reports have been written. The USGMRL also evaluates technical proposals on improving safety in grain-handling facilities submitted to the Department.

The Safety Coordinating Subcommittee also maintains liaison with Congress, other governmental agencies, private industry, trade associations, union groups, the academic community, and others who have a concern for safety in the grain-handling system.

The subcommittee held periodic meetings; prepared the USDA Grain Storage, Handling, and Processing Safety Coordinating Subcommittee annual report for fiscal year 1988; and distributed it to departmental officials, congressional committees, other governmental agencies, industry, union, trade groups, universities, insurance groups, and foreign countries upon request.

Members of the Subcommittee visited the U.S. Bureau of Mines test facility at Lake Lynn, WV. They watched two grain dust explosion demonstrations and a coal dust explosion suppression test. Some of the technology developed to protect coal mines from dust explosions may be appropriate for use in grain-handling facilities.

The USDA Grain Elevator Safety Program initiatives are presented in exhibit A. These initiatives include the responsible lead agencies, updated project descriptions, and a summary of accomplishments in fiscal year 1989.

PRIVATE SECTOR AND GOVERNMENT

The U.S. Bureau of Mines continues to conduct studies on grain dust explosions. A report of their current effort is contained in exhibit B.

During the past 7 years, private industry, trade organizations, and union groups, as well as the scientific community and the Federal Government, have increased their efforts to reduce fires and explosions in the grain-handling system. In particular, the National Grain and Feed Association (NGFA) has demonstrated its concern for safety by initiating 46 separate research and education projects which have resulted in improved elevator design, engineering, and technology. They have examined explosion venting, suppression, electrostatics, dust control, and several other areas. NGFA has invested nearly $3 million in undertaking these research studies.

Forty-six projects have already been completed and information made available to the agricultural grain community worldwide.

NGFA has a committee charged with the development and dissemination of fire explosion safety information to the industry. This committee utilizes resources, including USDA's NAL, university holdings, and trade association programs, as well as NGFA's own library and research findings. The NGFA coordinates this information program with USDA, other

governmental groups, and State and other national trade associations. A listing of NGFA's research projects provided to the USDA Safety Coordinating Subcommittee is shown in exhibit C.

During the past 7 years, a safety and health education program has been carried out by the Grain Elevator and Processing Society (GEAPS). The GEAPS Grain Industry Safety and Health Center conducted seminars designed to provide grain-handling facility management and other interested groups with the resources needed to develop, implement, and manage safety and health programs for employees working in grain-handling facilities. A listing of GEAPS safety programs provided to the USDA Safety Coordinating Subcommittee is shown as exhibit D.

The Food and Allied Service Trades department of the American Federation of Labor, and Congress of Industrial Organizations have conducted extensive training programs for grain elevator workers in the area of safety and health. They have developed slide/tape training materials as well as numerous pamphlets and fact sheets.

Enforcement of Federal standards governing workers' safety is the responsibility of OSHA. OSHA has published in the Federal Register its standard for grain-handling facilities.

Exhibit A

USDA GRAIN ELEVATOR SAFETY PROGRAM INITIATIVES

NO.	INITIATIVE	LEAD AGENCY
1.	Establish central reporting, tracking, and monitoring system of explosion incidents.	FGIS
2.	Establish central coordination, development, and dissemination of promotional and training material to the private sector and agricultural community.	ES
3.	Establish central collection, maintenance, and distribution of information related to research in grain-handling facilities.	NAL
4.	Evaluation and control of damage to grain from handling.	ARS
5.	Measurement and control of dust emission in grain-handling facilities.	ARS
6.	Explore and communicate alternate economical uses of grain dust. (Completed)	ARS
7.	Systematic studies on explosion and fire risks and hazards of grain-handling facilities.	ARS
8.	Conduct basic/applied research on the effects of relative humidity on explosions. (Completed)	ARS

USDA GRAIN STORAGE, HANDLING, AND PROCESSING
SAFETY PROGRAM INITIATIVES

FEDERAL GRAIN INSPECTION SERVICE

BACKGROUND:

The Administrator of FGIS, W. Kirk Miller, chairs the subcommittee. FGIS is responsible for establishing grain standards, promoting these standards within the industry, and regulating the inspection and weighing of all grain shipped from this country. FGIS maintains a nationwide system that ensures integrity in the inspection, weighing, and handling of U.S. grain both in the domestic and the export market. Federal employees work at export elevators, commodity plants, and other grain-handling facilities to accomplish this mission.

INITIATIVES:

(Initiative 1) FGIS established a central reporting, tracking, and monitoring system for grain dust explosion incidents. Fiscal year 1981 through 1989 information is contained in figures 1 through 15.

(FGIS Internal Initiative) FGIS provides a comprehensive safety and occupational health program to protect its employees who work in private sector grain-handling facilities. During FY 1989, some highlights of this internal program included the following:

a. Employees received training in hazard recognition and avoidance.

b. Employees were trained in first aid and cardiopulmonary resuscitation.

c. Monthly meetings were held to discuss safety and health issues. Training materials were distributed. The employees were encouraged to actively participate in the safety and occupational health program.

d. Research to determine an alternative to using the human nose to determine odor in grain is continuing.

e. A cooperative effort has been made to develop more effective safety and health criteria for working in railyards. FGIS employees developed a proposal with the assistance of members of the NGFA. The proposal was sent to the Federal Railroad Administration, which reviewed and approved the proposal. It was then sent to OSHA and the USDA Occupational Safety and Health Management Division, which reviewed and approved the proposal.

The new procedures were published as part of our directives system during fiscal year 1989. The new methods should improve employee safety and will not adversely affect the performance of our mission.

f. We arranged a visit to the U.S. Bureau of Mines Research Center at Lake Lynn, West Virginia. The purpose of the visit was to familiarize members of the subcommittee with the research capabilities of the Bureau of Mines and to observe a series of dust explosions. The Bureau of Mines is considered to be the leading authority in the United States on coal dust explosions.

g. Field employees received training on the storage, use, and disposal of chemicals as part of the Federal Hazard Communication Program.

Figure 1 - Grain dust explosions FY 1989

Facility/Location	Date	Injuries	Deaths
Louis Dreyfus Reserve, LA	10/05/88	0	0
Corpus Christi Public Corpus Christi, TX	11/06/88	0	0
Con Agra-Fruen Mill Minneapolis, MN	12/02/88	0	0
Midwest Grain Atchinson, KS	02/02/89	0	0
Quaker Oats Cedar Rapids, IA	02/14/89	0	0
Zen Noh Grain Convent, LA	03/30/89	0	0
A.E. Staley Mfg. Decatur, IL	05/12/89	0	0
Montezuma Coop Montezuma, KS	07/27/89	2	0
Ferruzzi, U.S.A. Myrtle Grove, LA	08/16/89	0	0
Cargill Elevator Bingham Lake, MN	09/22/89	3	2
	TOTAL	5	2

The information regarding grain dust explosions was reported to FGIS through the cooperation of universities, insurers, trade groups, FGIS personnel, and a news clipping service. FGIS does not investigate grain dust explosions, and the public sector is not required to report explosions to FGIS. No deaths or injuries occurred to FGIS employees in any of the above listed incidents.

Figure 2 - Grain dust explosions FY 1989

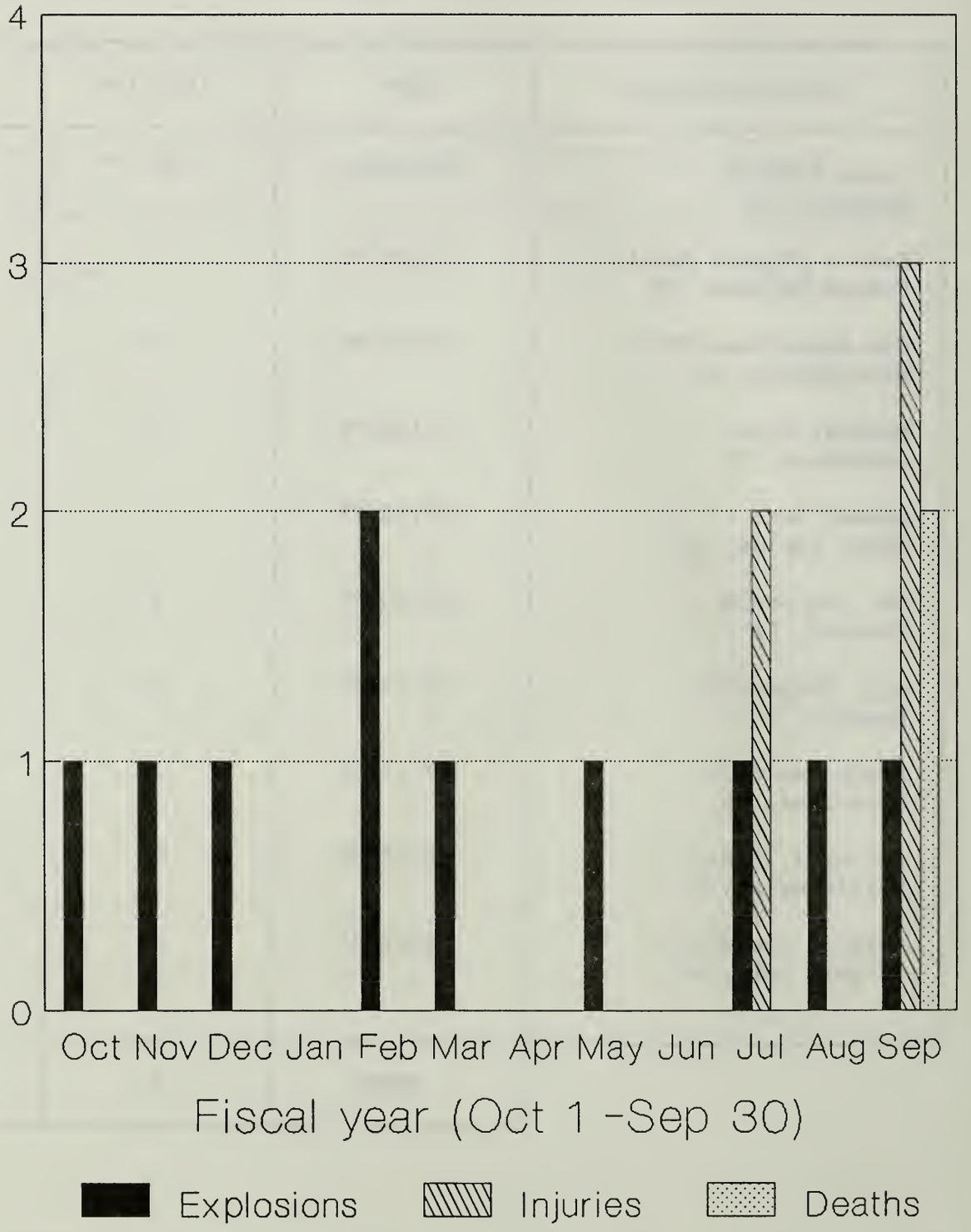


Figure 3 - Grain dust explosions FY 1981-89

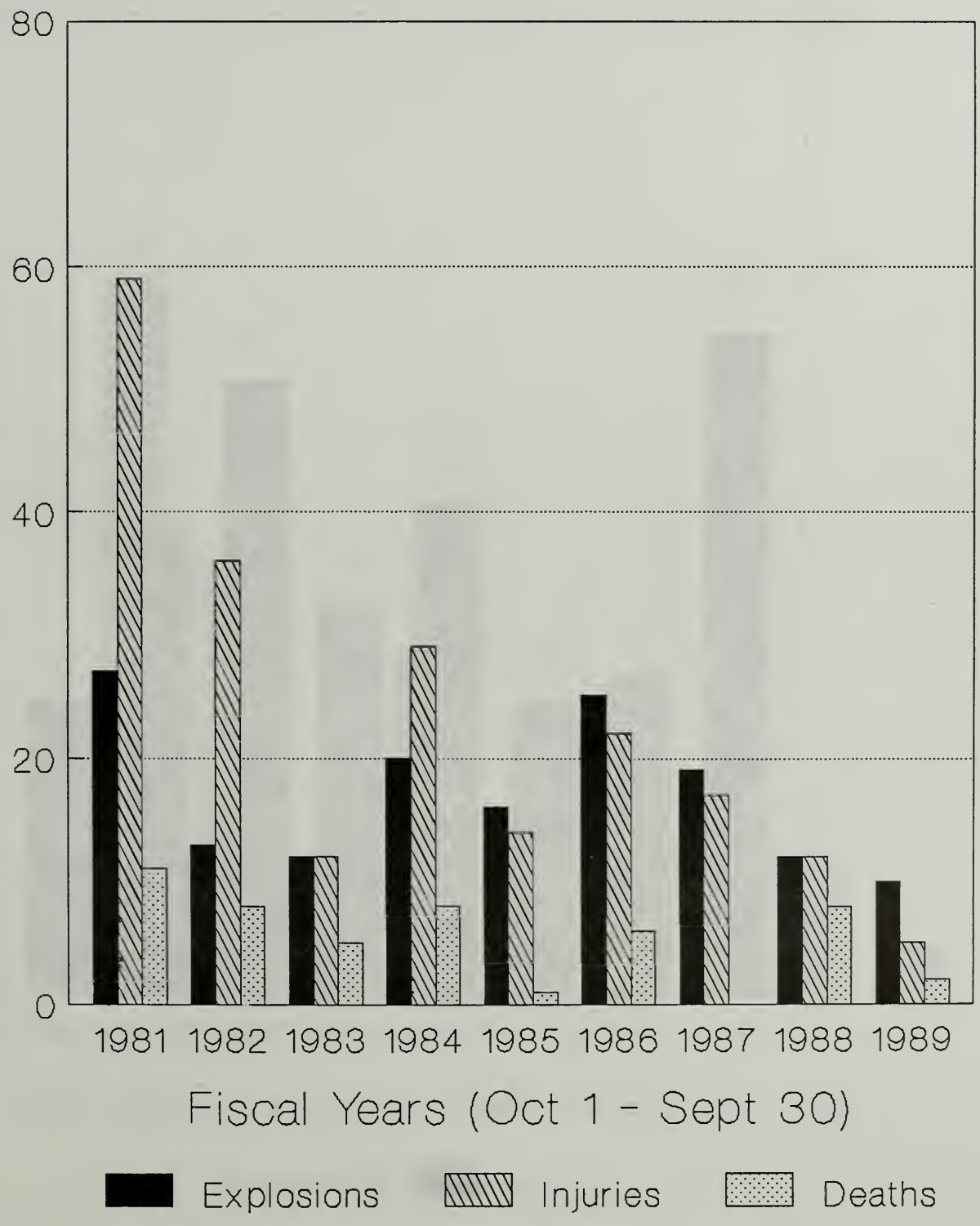


Figure 4 - Grain dust explosions FY 1981-89

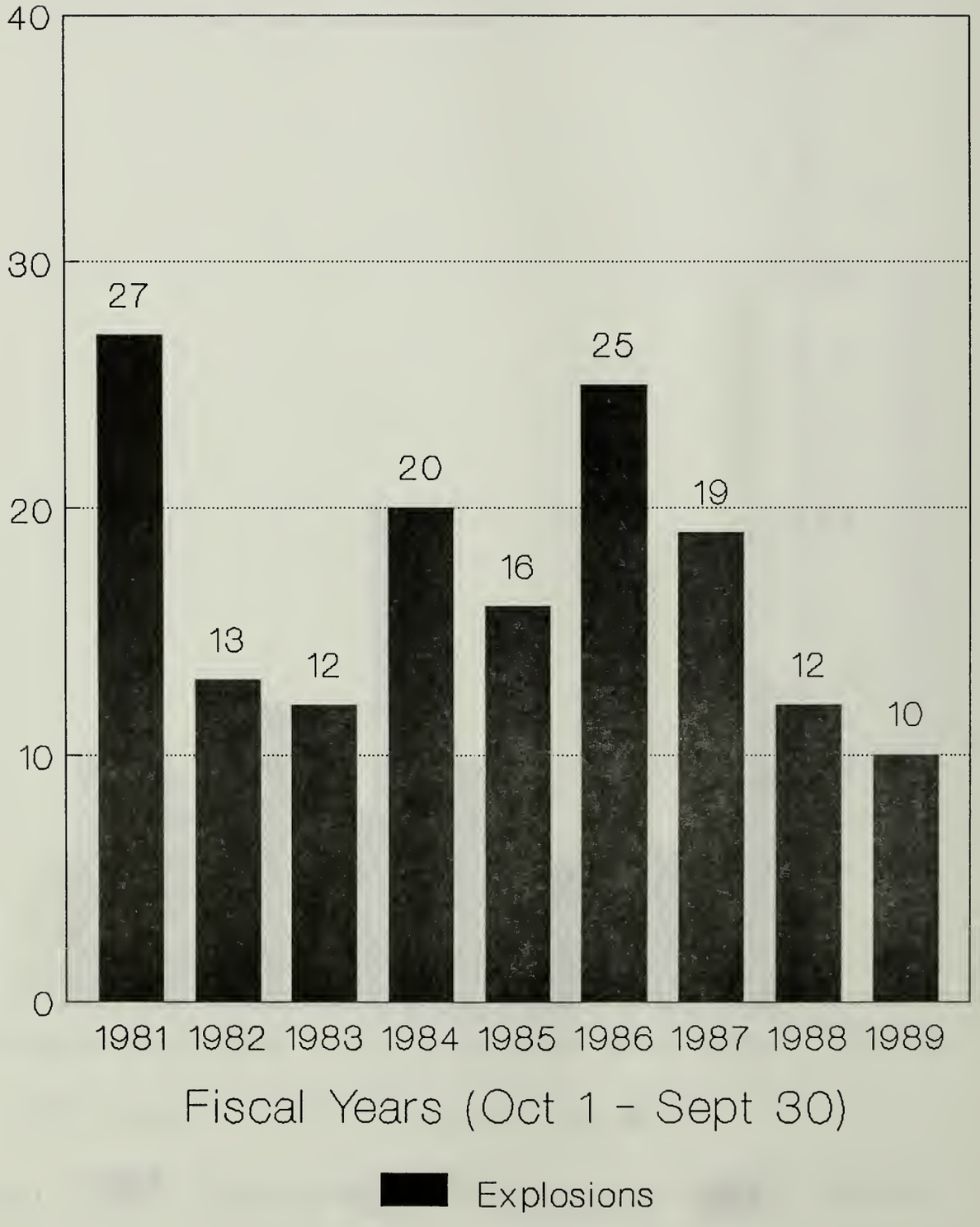


Figure 5 - Grain dust explosions FY 1981-89

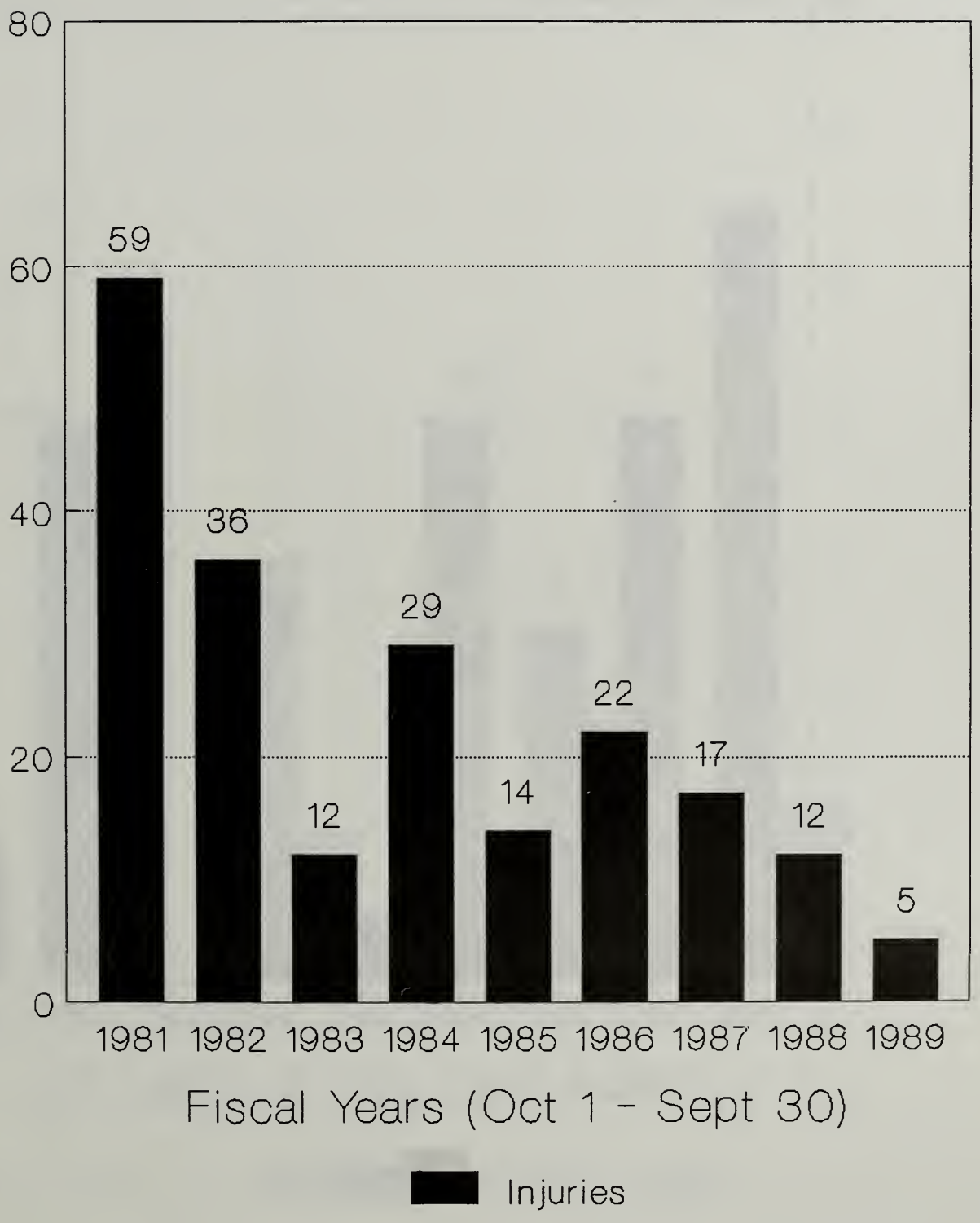


Figure 6 - Grain dust explosions FY 1981-89

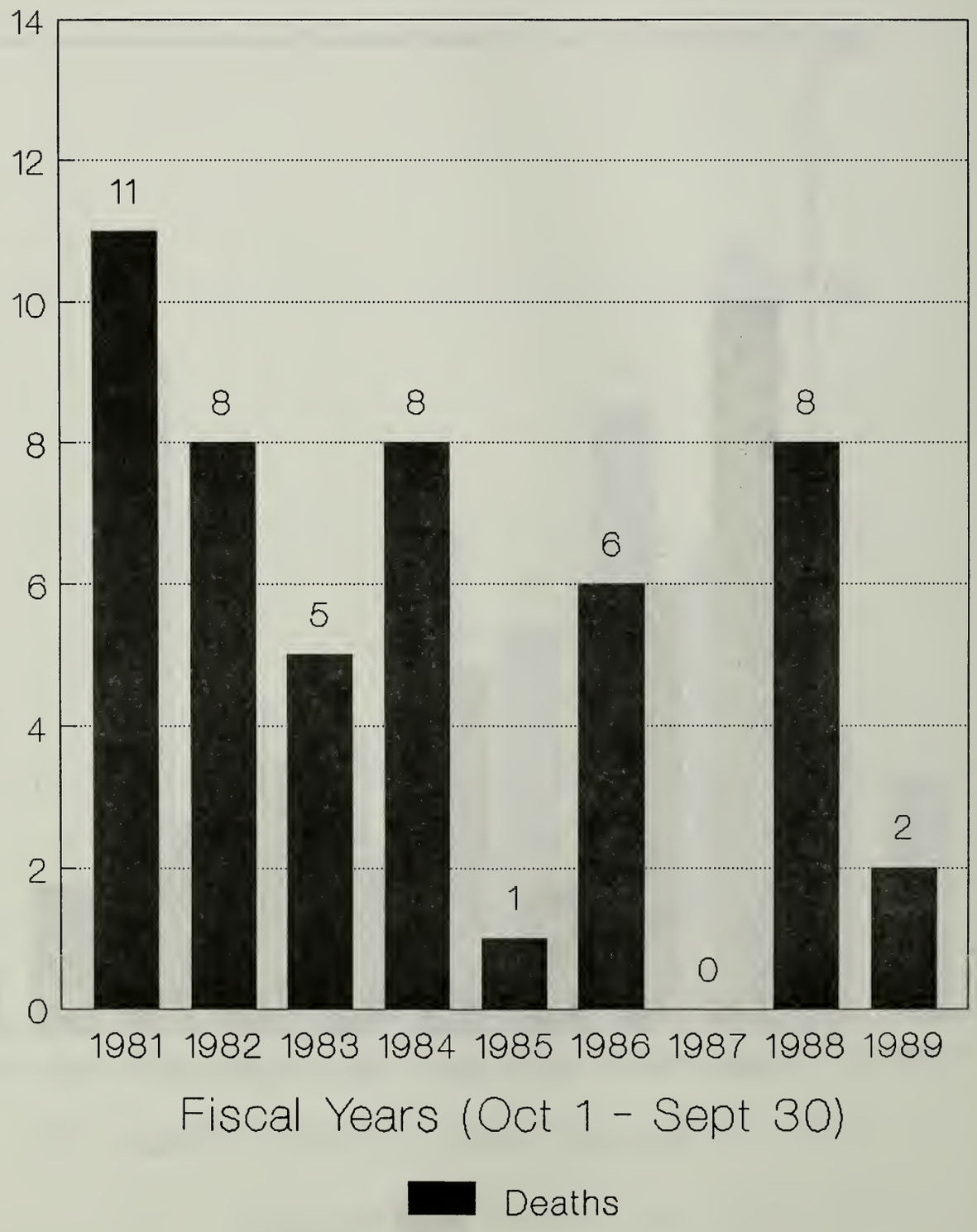


Figure 7 - Grain dust explosions FY 1981-89

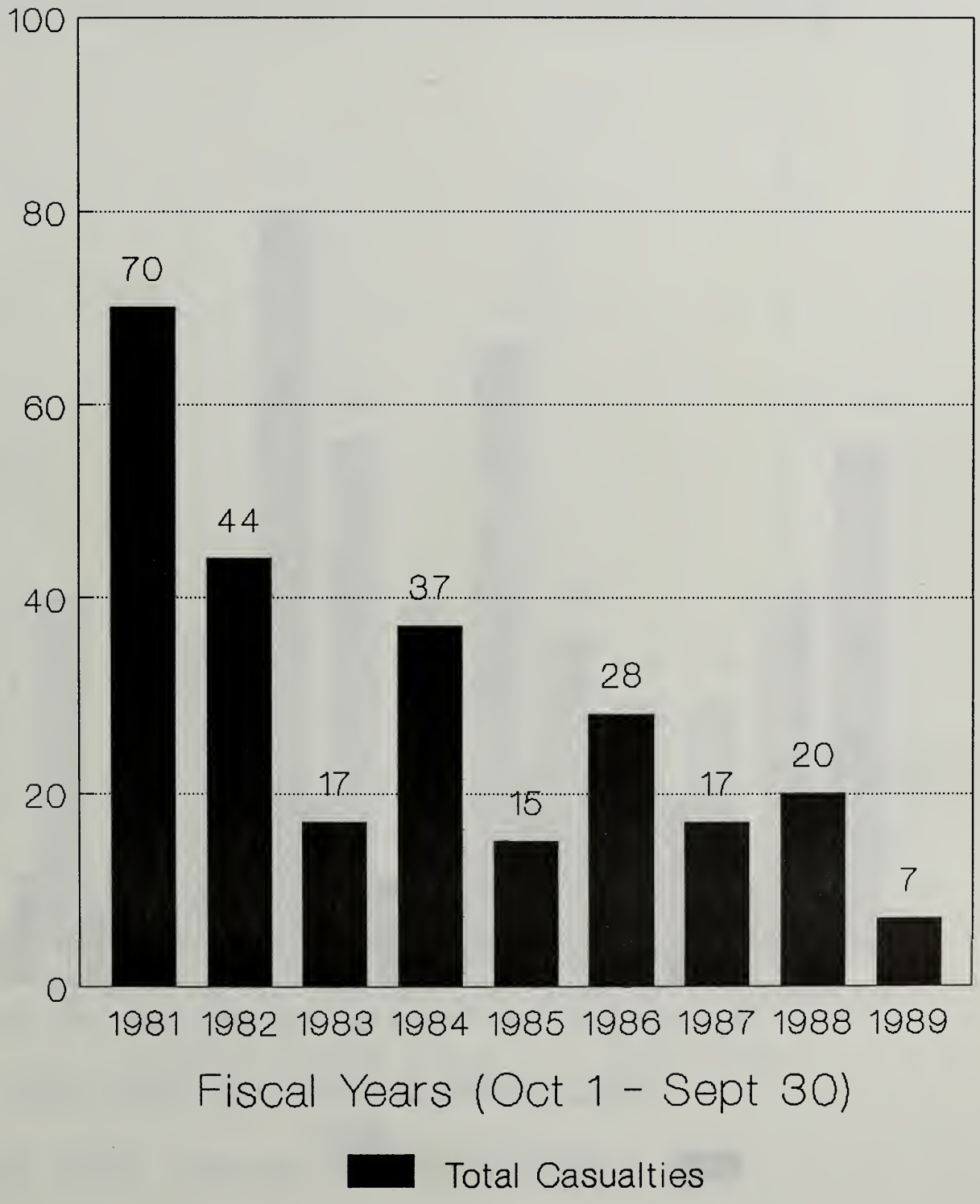


Figure 8 - Grain Dust Explosions Average FY 1981-89 by Month

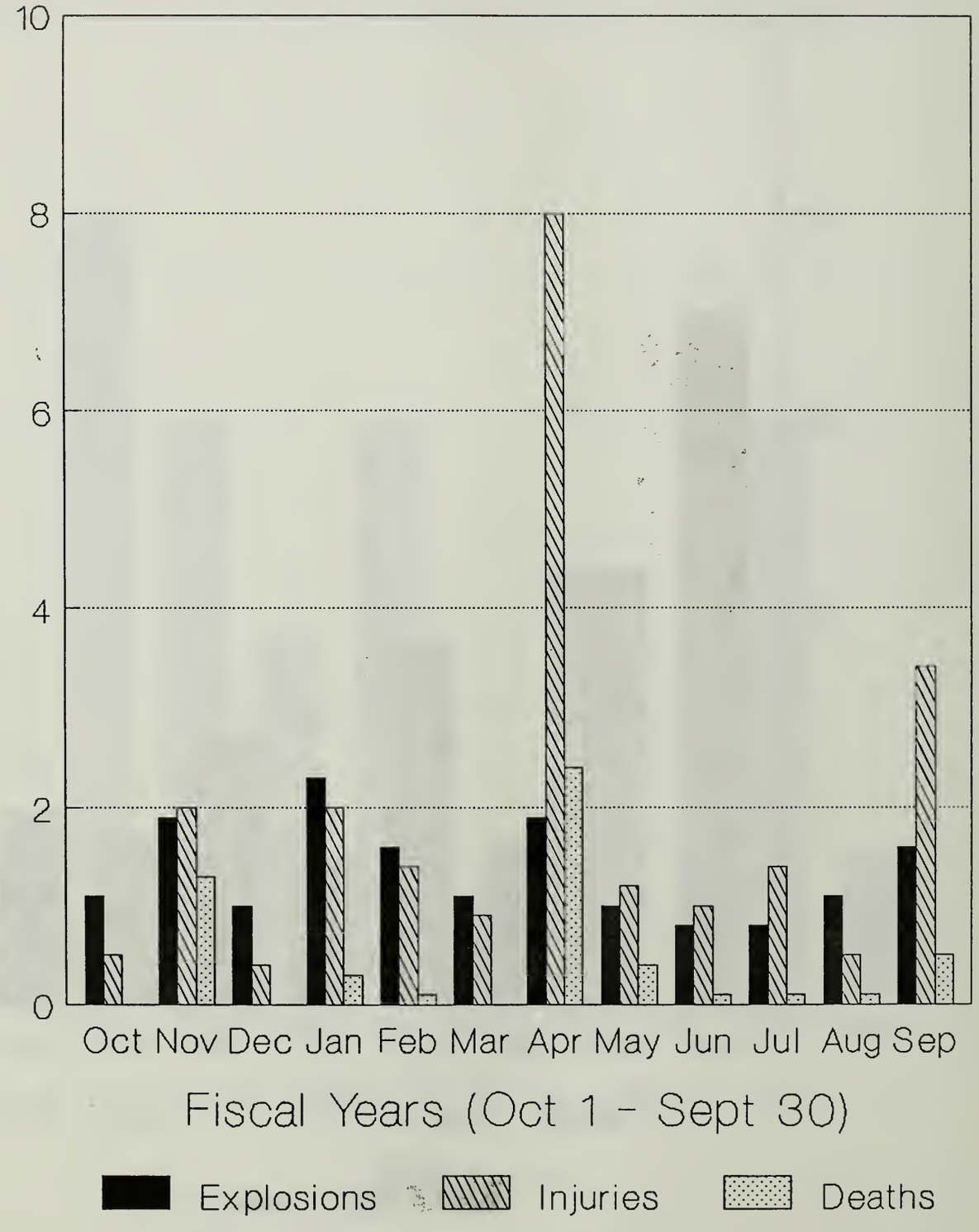


Figure 9 - Grain Dust Explosions Average FY 1981-89 by Month

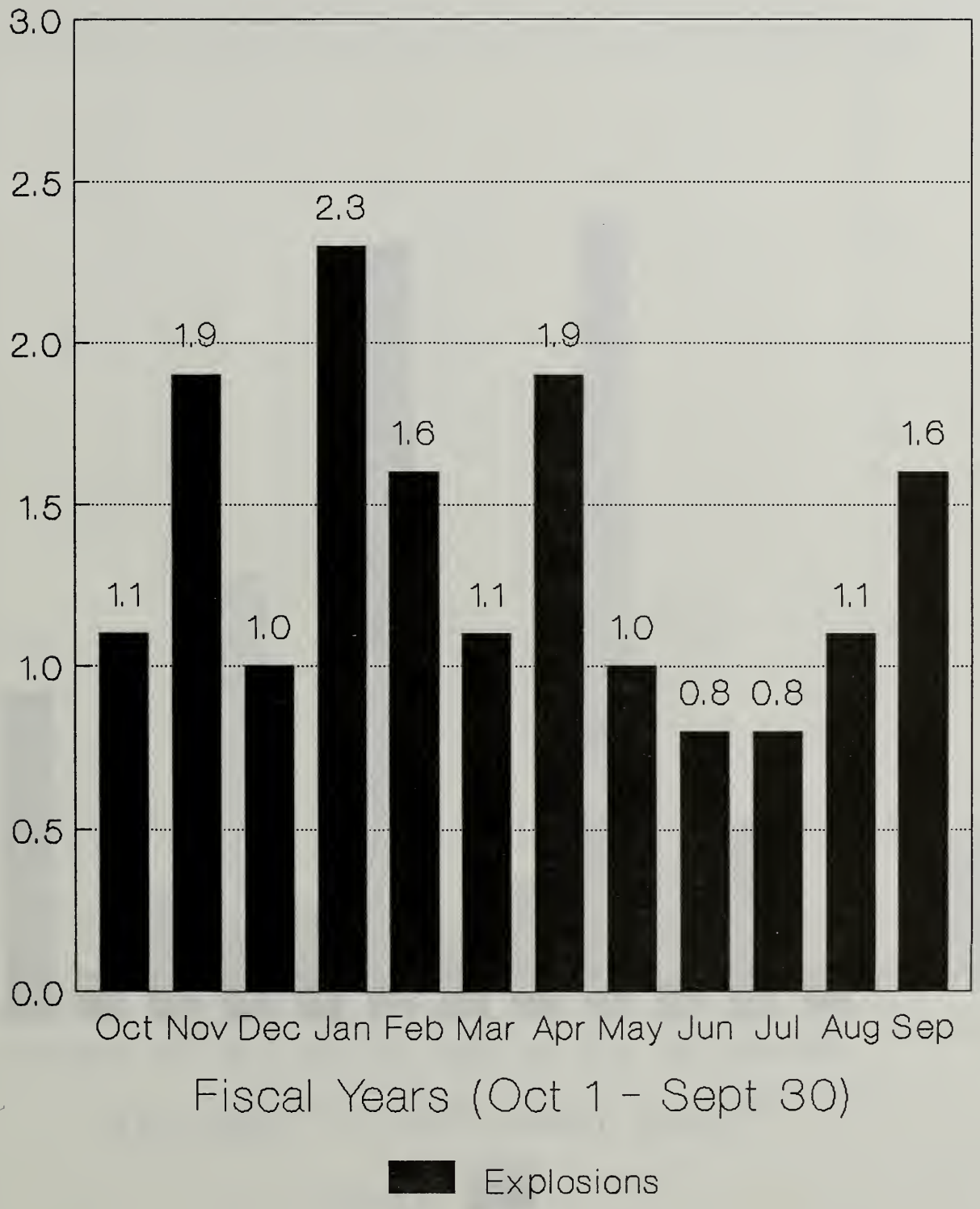


Figure 10 - Grain Dust Explosions Average FY 1981-89 by Month

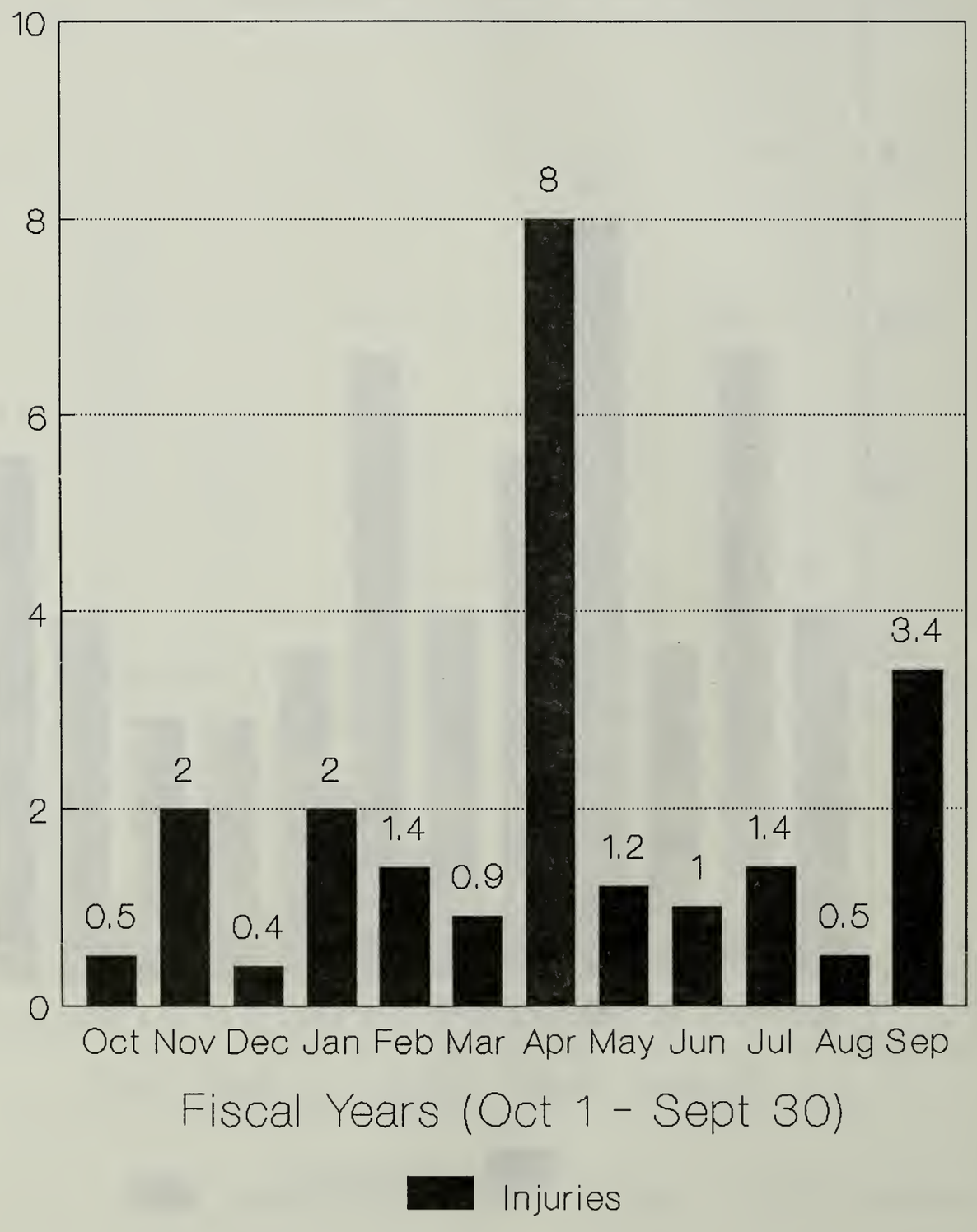


Figure 11 - Grain Dust Explosions Average FY 1981-89 by Month

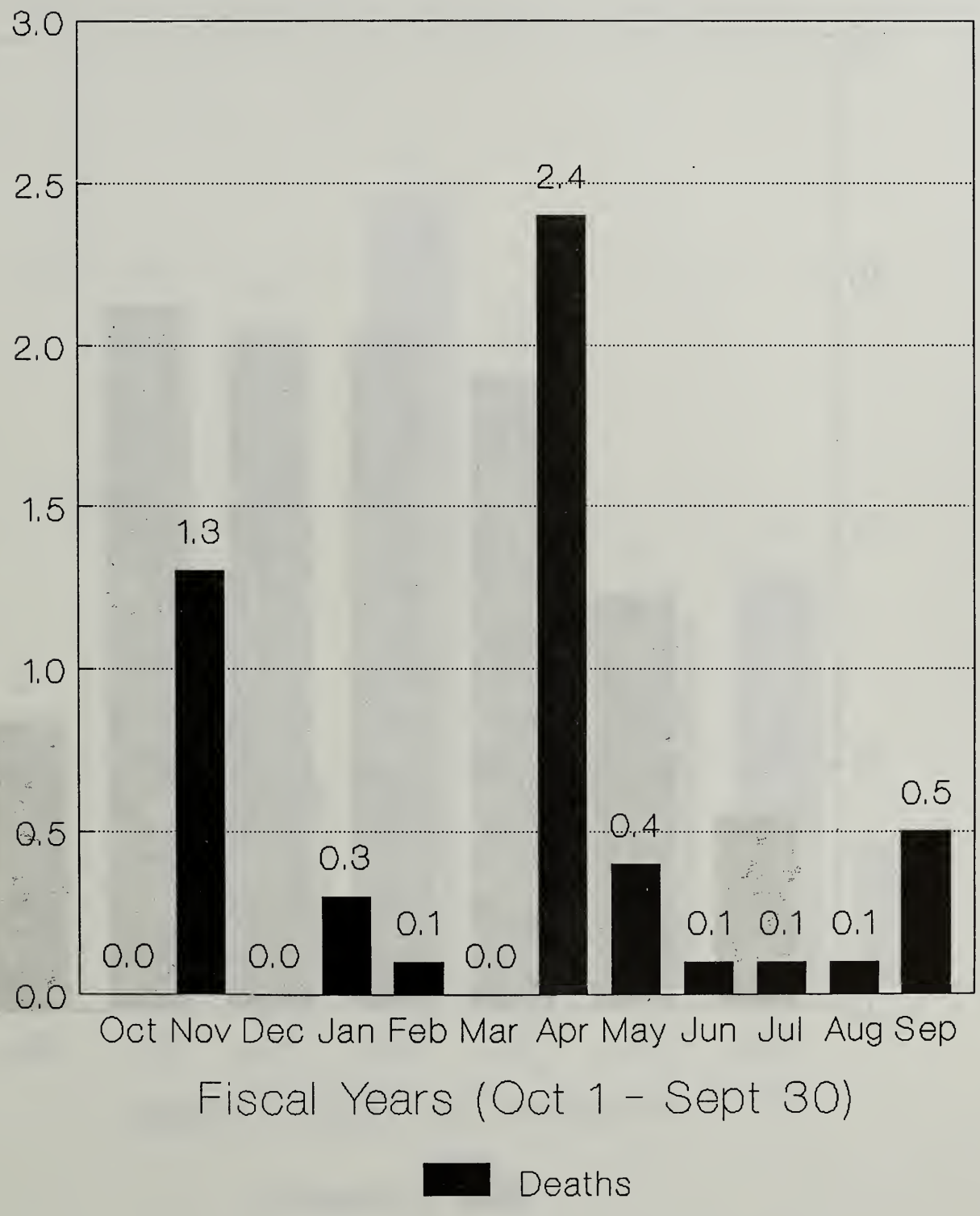


Figure 12 - Grain dust explosions FY 1981-89

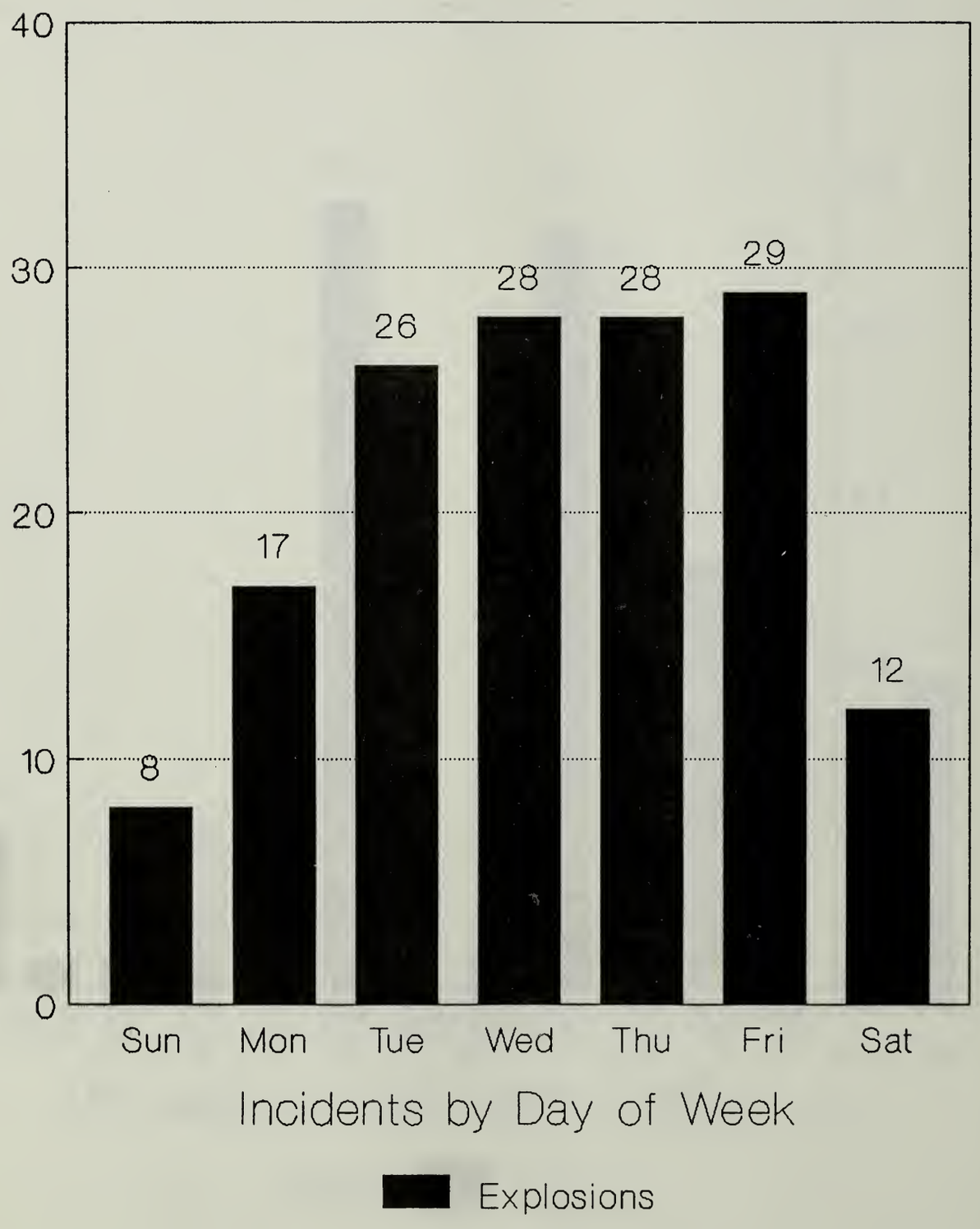


Figure 13 - Grain dust explosions FY 1981-89

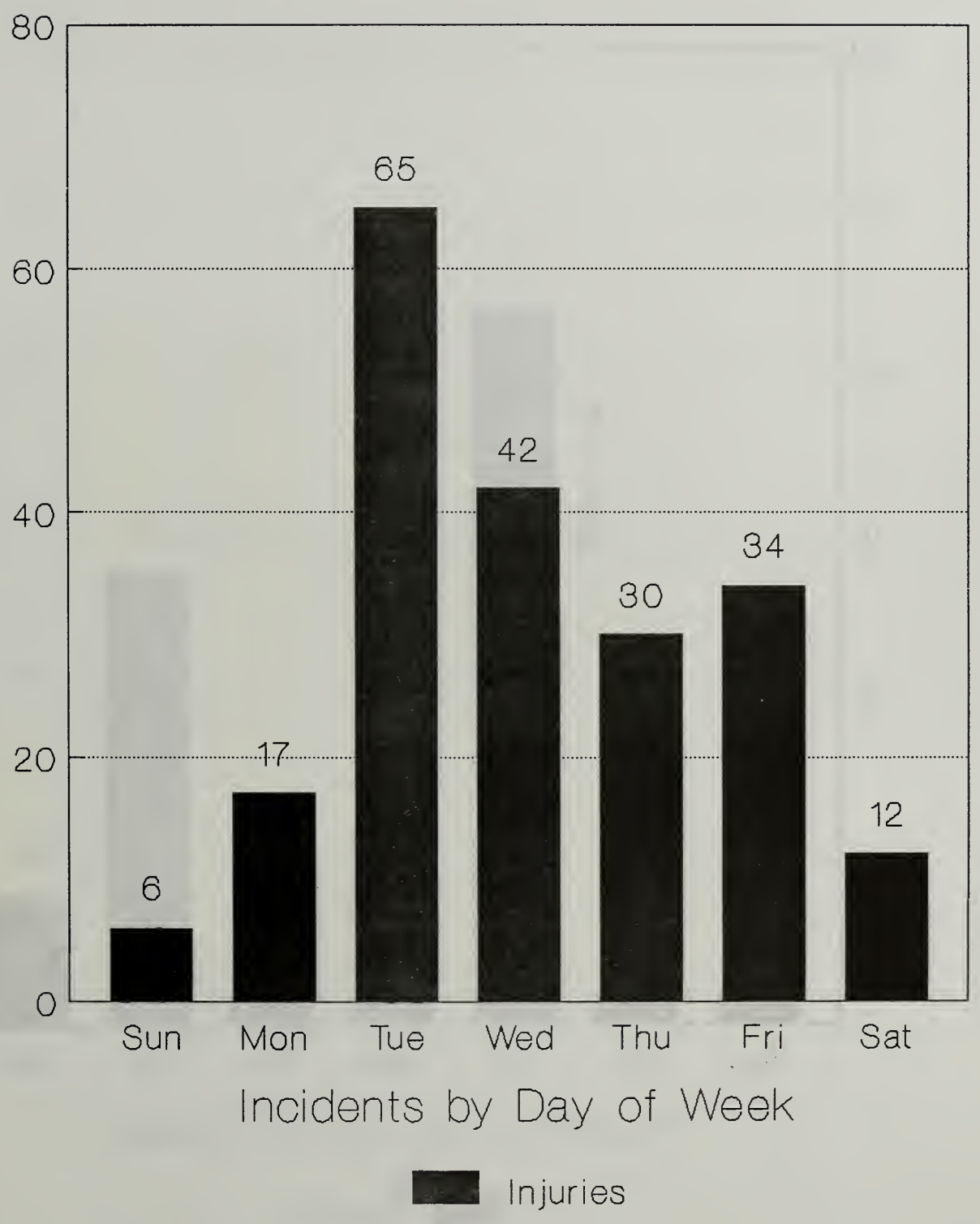


Figure 14 - Grain dust explosions FY 1981-89

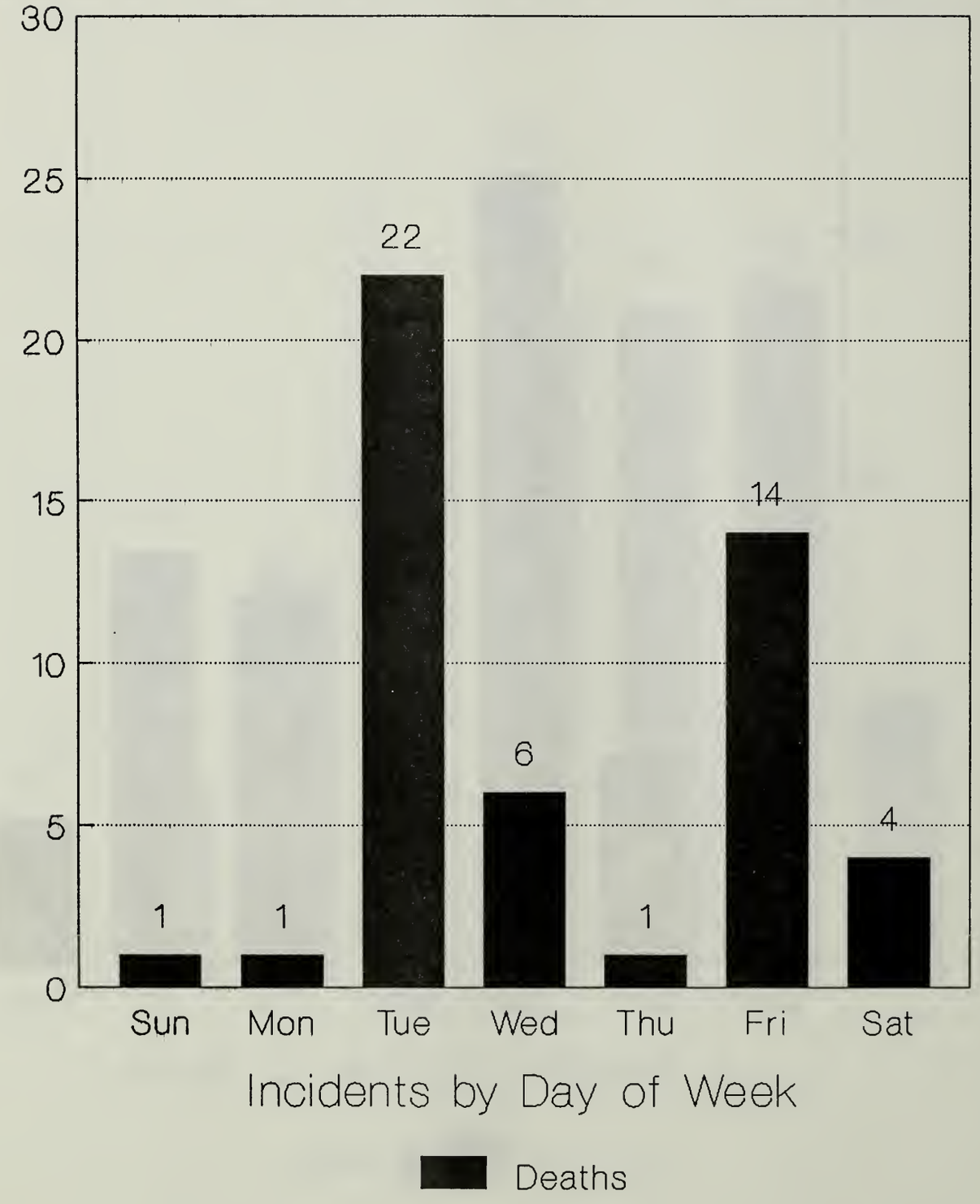
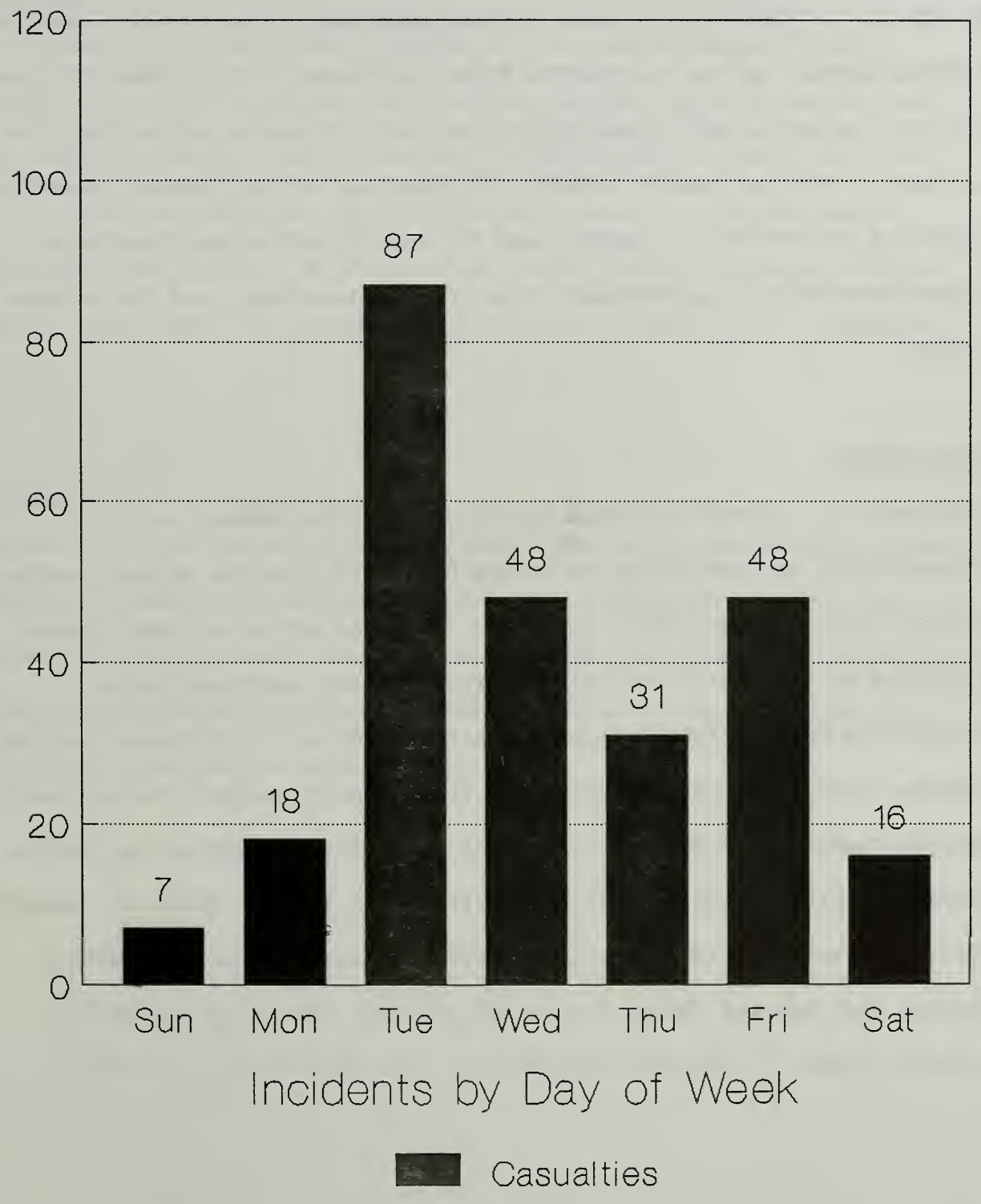


Figure 15 - Grain dust explosions FY 1981-89



USDA GRAIN STORAGE, HANDLING, AND PROCESSING
SAFETY PROGRAM INITIATIVES

EXTENSION SERVICE

BACKGROUND:

The ES is the educational agency of the Department of Agriculture and the Federal partner in the Cooperative Extension System (CES). The CES links research, science, and technology to the needs of people where they live and work. This nationwide network and resources of professional staff and community volunteers is a unique and integrated partnership involving Federal/State/county government, research, agribusiness, and the private sector.

INITIATIVES:

(Initiative 2) Enhance central coordination, development, and dissemination of promotional and training material to the private sector and agricultural community. During FY 1989, the series of fact sheets developed by five North Central Universities have continued to be distributed to interested groups and other agencies. Additional training sessions were developed and presented for emergency medical technicians in several States. The Northeast Regional Agricultural Engineering Service (NRAES) special bulletin entitled "First on the Scene," NRAES-12, January 1989, has been distributed to all States that are members of NRAES or Midwest Plan Service (MWPS). A new ES position for an agri-industry systems engineer to provide leadership in this area has been filled.

USDA GRAIN STORAGE, HANDLING, AND PROCESSING
SAFETY PROGRAM INITIATIVES

NATIONAL AGRICULTURAL LIBRARY

BACKGROUND:

NAL is one of three national libraries in the United States. The library's collection of books and journals totals 2 million volumes and covers all the subject areas in which the Department of Agriculture is active. NAL also produces the AGRICOLA data base, one of the world's major data bases, which can be searched online through database vendors and which can also be purchased on CD-ROM and be searched on a personal computer.

INITIATIVE:

(Initiative 3) NAL has established a Grain Dust Safety Information Center, a central collection of information related to research on grain dust. A portion of this collection has been microfilmed for ease of distribution. During FY 1989, additional information was added to the collection and requests for information were filled.

USDA GRAIN STORAGE, HANDLING AND, PROCESSING
SAFETY PROGRAM INITIATIVES

AGRICULTURAL RESEARCH SERVICE

BACKGROUND

The ARS U.S. Grain Marketing Research Laboratory (USGMRL) located in Manhattan, Kansas, serves as the lead center for departmental research on grain dust and safety. The USGMRL conducts in-house research, evaluates technical proposals submitted to the Department, and otherwise provides expertise to coordinate industry and other scientific research related to grain dust. Publication of planned research on certain aspects of dust suppression with oil additives is essentially complete. Current on-site research is focused on grain-handling technology which can be used to minimize dust emissions, measure dust emissions, measure grain breakage in shelled corn in relation to drying history, and develop an expert system to aid elevator managers with safety regulations compliance.

INITIATIVES (Based on original guidelines established in 1982):

(4) Evaluation and Control of Damage to Grain from Handling.

(5) Measurement and Control of Dust Emission in Grain-Handling Facilities

(7) Systematic Studies on Explosion and Fire Risks and Hazards of Grain-Handling Systems.

ACTION FY 1989

Initiative 4.

The flow rates of wheat, corn, sorghum, and soybeans through circular and square vertical orifices were determined. An

empirical equation was developed to predict volume flow rate of different grains through vertical orifices as a function of orifice type, orifice size, and grain moisture content. Tests to determine velocity and trajectories of grain flowing from spreader troughs of different lengths and incline angles were conducted. Mathematical models to predict the grain velocities and trajectories were developed and verified.

Publications:

1) Chang, C.S., H.H. Converse, and J.L. Steele. 1988. Flow rates of grain through vertical orifices. ASAE Paper No. 88-6574. Annual Winter Meeting of the ASAE, Chicago, IL. December 13.

2) Chang, C.S., H.H. Converse, and J.L. Steele. 1988. Trajectories of grain particles from a trough-type grain spreader. ASAE Paper No. 88-6577. Winter Meeting of ASAE, Chicago, IL. December 13.

Initiative 5.

Combine-harvested corn (23-25% moisture) was dried using different drying procedures and/or drying air temperatures. The lowest dust emissions were obtained from the natural air dried corn. The highest dust emissions were from corn in-bin dried at 105 >C. For repeated elevator transfers, BCFM in the test lots

tended to increase linearly at different rates in relation to drying treatment. The rates of increase were highly correlated to certain breakage susceptibility scores. Initial stages in the development of an advisory expert system for prevention of fire and explosion hazards in grain elevators were completed. Based on information supplied by the user, the expert system lists potential safety problems including points of high dust emission and provides recommendations with particular reference to OSHA grain elevator safety regulations.

Publications:

1) Converse, H.H. and S.R. Eckhoff. 1989. Corn dust emissions with repeated elevator transfers after selected drying treatments. Approved for publication in Applied Engineering in Agriculture, August 1989.

2) Eckhoff, S.R., P.C. Wu, D.S. Chung, and H.H. Converse. 1988. Magnitude and sources of error in Wisconsin breakage tester results. Trans. of the ASAE 31(4):1247-1250.

3) Eckhoff, S.R., P.C. Wu, D.S. Chung, and H.H. Converse. 1988. Moisture content and temperature effects on Wisconsin breakage tester results. Trans. of the ASAE 31(4):1241-1246.

4) Wu, P.C., S.R. Eckhoff, D.S. Chung, and H.H. Converse. 1988. Breakage susceptibility of rewetted and blended corn samples. Transactions of ASAE 31(5):1581-1584.

5) Shenoi, S., C.S. Chang, H.H. Converse, and L.T. Fan. 1989. An expert system for grain elevator hazard prevention. Mid-Central Region Meeting of the ASAE, St. Joseph, MO. April 14.

Initiative 7.

From the first annual report for the project, "Grain Dust Explosion and Control" PL-ARS-135, conducted by the Institute of Heat Engineering, Warsaw University, Warsaw, Poland, in cooperation with the Aviation Institute, Warsaw University and the Central Mining Institute Experimental Mine "Barbara," Mikolow, Poland, the areas of research include:

* Dynamics of dust-air mixture ignition
* Studies of "laminar" and "turbulent" dust flames
* Acceleration of dust flame
* Suppression of grain dust explosion

The research or dynamics of grain dust-air mixture ignition focused on the preparation of the test stand for both spark ignition and ignition tests using a dynamically heated surface.

Early results indicated a strong influence of turbulence level on ignition parameters. It was shown that the turbulence can increase the flame propagation velocity up to 4 times, compared to the flame propagation in an "undisturbed" dust-air mixture.

From the second annual report, the large-scale research on explosive combustion of dust layers was carried out at the experimental mine. The influence of ignition source on critical dust layer thickness was investigated. It was found that a dust loading of 100 g/m2 on the gallery floor was sufficient for explosion, propagating a velocity close to 80 m/s and creating an overpressure of 50 kPa. The above loading level equates to a dust layer thickness of about 0.33 mm, which is substantially less than current OSHA requirements. On-site review of the project in 1989 has been delayed pending arrival and testing of corn dust at the experimental mine.

Dr. Dunkle participated in discussions between OICD and USSR scientists relating to cooperative grain dust and explosion research. ARS currently expects to contribute technical expertise only if cooperative activities become a reality.

Publications:

1) Goral, P., and P. Wolanski. 1989. The influence of turbulence on ignition of grain dust-air mixture by a hot

wire. Proc. XIth International Symposium on Combustion Processes, Miedzyzdroje, Poland, Sept. 27.

2) Sacha, W., P. Wolanski, and Zalesinski. 1989. Shock wave driven combustion of grain dust-air mixture. Proc. XIth International Symposium on Combustion Processes, Miedzyzdroje, Poland, Sept. 27.

3) Wolanski, P., and M. Wolinski. 1989. Experimental investigations on shock wave interactions with combustible dust layer. Proc. XIth International Symposium on Combustion Processes, Miedzyzdroje, Poland, Sept. 27.

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE

BACKGROUND:

Agricultural Stabilization and Conservation Service (ASCS) administers farm commodity, conservation, environmental protection, and emergency programs.

These programs provide for commodity loans and price support payments to farmers; commodity purchases from farmers and processors; acreage reduction; cropland set-aside and other means of production adjustment; conservation cost sharing; and emergency assistance.

Financing of ASCS commodity programs is through the Commodity Credit Corporation (CCC), a Government entity for which ASCS provides operating personnel.

ASCS maintains a headquarters office in Washington, D.C.; an office in each State and in most counties; a Caribbean area office in Puerto Rico which also serves the Virgin Islands; a commodity office and a management office in Kansas City, Missouri; and an Aerial Photography Field Office in Salt Lake City, Utah.

The agency is headed by an administrator, an associate administrator, and four deputy administrators.

The Deputy Administrator, Commodity Operations, administers activities in commodity operations, warehousing, storage agreements, and the Kansas City Commodity Office (KCCO). Warehouse examiners assigned to the KCCO perform warehouse examinations at grain-handling facilities licensed under the United States Warehouse Act and/or approved under the CCC's Uniform Grain Storage Agreement.

INITIATIVE

(ASCS Internal Initiative) Warehouse examiners have occasion to enter storage structures containing bulk grain. During FY 1989 a safety harness was evaluated for the purpose of providing our examiners with a safe means of entering and exiting these bulk grain structures. Based on our evaluation of this equipment, we are proposing a budget request during FY 1990 to purchase these safety harnesses and train our field examiners in their use.

Exhibit B

Bureau of Mines
Combatting Grain Dust Explosions

A triggered barrier system originally developed and commonly used to control coal dust explosions may be directly applicable to the grain industry for controlling grain dust explosions.

The method uses suspended water tanks to extinguish the flame front before it can trigger successive secondary explosions, often the most damaging.

By releasing water droplets in the path of the explosion flame, it is possible to achieve extinction of the explosion flame, thereby limiting the range of damage, according to the U.S. Bureau of Mines.

The grain industry system currently being developed is a formed sheet of explosive used to expel the extinguishing material from a 40-liter Styrofoam container. The unit is activated by a solar panel which provides electrical power to fire the electrical detonators. The solar panel is activated when it picks up the radiation from the flame front. The system requires no batteries, is maintenance-free, and is explosion-powered.

Secondary grain dust explosions are analogous to those in underground coal mines in the sense that sufficient fuel in the form of dust cannot be eliminated despite good "housekeeping" efforts, sufficient

oxygen is almost always present, and thermal ignition sources cannot be eliminated because equipment failure in the transport of materials cannot be eliminated. Because none of these explosion factors can be forever eliminated, there is no simple way of preventing an explosion.

However, triggered barrier systems, which have the capability of rapid detection of an explosion flame, and quick release of an extinguishant just ahead of the flame offer a means of suppressing an explosion. Crucial to the success of the triggered barrier approach is the determination of the desired time interval between detection and rapid dispersion of the extinguishant. If the interval is too short or too long, the barrier approach will not be effective.

Data on the propagation parameters for full-scale grain dust explosions are needed to identify the time interval window needed for successful operation of triggered barriers and where to place them.

The system appears to have the greatest advantages in application in grain elevator legs, basements, and galleries. Additives to keep the water from freezing, such as glycol or salt, should not affect the water's ability to stall an explosion.

The Bureau feels that this triggered barrier technology for coal mines could be refined and applied to combat and reduce the severity of the grain dust explosions.

Exhibit C

National Grain and Feed Association
Fire and Explosion Research Council Research Project

The National Grain and Feed Association's Fire and Explosion Research Council was established in July 1978 with a single overall goal: to save lives and property. To meet this goal, the Council initiated a research program to investigate causes of and ways to prevent or reduce the impact of fires and explosions in grain-handling facilities.

Fire and explosion research has been financed through a research fund of more than $1.4 million, donated by 300 industry firms. All sectors of the industry contributed, including 194 county elevator operators who pledged an average of more than $1,100 each. Millers, processors, and State and regional grain and feed associations affiliated with the national also contributed to the fund. Sponsorship of the research program has been a total team effort involving both privately owned and cooperative firms.

The research program has three major objectives:

-- To gather information on available technology to control, prevent, and help eliminate fires and explosions in grain-handling facilities;

-- To conduct an extensive research effort to learn more about the causes of explosions and ways to control or prevent them; and

-- To disseminate written and oral information to all who are interested.

The Council places emphasis on identifying, communicating, and encouraging the implementation of methods that are known to reduce fire and explosion hazards, while obtaining through research new knowledge to prevent such incidents.

Thus far, over 160 proposals have been submitted and evaluated. Of the projects selected for funding; 33 research projects and 10 education projects have been completed and final reports are available. In addition, three major elevator design conferences were held and education and information materials have been produced and disseminated throughout the United States and overseas.

In addition to the $1.4 million research fund contributed by industry firms, the National Grain and Feed Association has spent approximately $700,000 since 1978 out of its own budget to pay administrative expenses related to this research effort. Grain industry firms have donated equipment, facilities, and commodities for use in research projects, thereby further extending the research dollars. Industry members have contributed time and talent, including salaries and transportation expenses exceeding $562,000 to monitor the progress of the fire and

explosion research projects. Research donations have earned interest that has added to the value of the research fund by over $810,000. Altogether, more than $3 1/2 million dollars of private funds will have been spent for fire and explosion research when the effort is completed.

RESEARCH RESULTS AND BENEFITS

Dust explosions are complex processes. Many variables and conditions can exist at facilities that influence the incidence and severity of an explosion. No single simple solution is available to eliminate explosions, and all options need to be explored. Thus, the research areas addressed by the Council address three of the four elements necessary for an explosion to occur--fuel, confinement, and ignition.

The Fire and Explosion Research Council, through the National Grain and Feed Association, has financed projects by 18 research organizations. The wide range of eminently qualified scientists and research institutions who have participated in the research includes universities, government, independent research firms, and the industry.

The research work is discovering new, practical knowledge that can be applied to grain-handling operations. In addition, the research serves as a constant reminder to the industry of the importance of safety consciousness at all levels of elevator activity. The research has:

-- Resulted in the first comprehensive compilation of available grain elevator technology to minimize the potential for explosion and maximize safety and as a result, significant new design, layout, and construction changes have been implemented;

-- Developed fundamental techniques on how to successfully vent bucket elevators;

-- Examined the feasibility of using suppression systems to extinguish a fire or explosion at its earliest stages in a bucket elevator and resulted in the development of a cost-effective, prepackaged dust explosion suppression device for use in bucket elevators;

-- Provided information on current practices of handling and utilizing grain dust;

-- Provided a better understanding about electrostatic characteristics of grain and grain conveying equipment;

-- Obtained information on the effectiveness of utilizing additives such as mineral oil, vegetable oil, and water to reduce airborne grain dust concentrations;

-- Discovered that gasses emitted from grain decomposition and

fumigation are not found in concentrations sufficient to pose an explosion risk under normal operating conditions;

-- Evaluated the potential for using aspiration or grain-cleaning devices to reduce dust concentrations inside an operating bucket elevator;

-- Evaluated the effectiveness of pneumatic dust control to reduce concentrations of dust in bucket elevators; and

-- Produced a manual on bearing selection, installation, and maintenance for the grain industry.

EDUCATION PROJECTS - THE NEW EMPHASIS

Information dissemination is seen as a major area for future Council activity. Future projects will be designed to diffuse the practical information discovered through research so that various options for addressing fire and explosion hazards can be considered by elevator owners and managers. In addition to the dissemination of research findings, the national will share the information gathered and presented at its conferences and seminars.

The Council's newest committee is the Education and Information Committee. This committee is responsible for projects to disseminate fire

and explosion safety information. As part of the Council's long-term goal of making safety information as widely available as possible, the committee recommends and oversees Council projects designed to increase awareness within the industry of methods available to prevent fires and explosions.

FUTURE RESEARCH WORK

The Fire and Explosion Research Council has pursued a wide variety of research efforts to fully evaluate grain dust explosion phenomena. As the research continues to progress, the Council will be evaluating the results for their implications towards practical means of addressing fire and explosion safety at grain facilities. In this way, future research can concentrate on projects that will yield the most promising methods to prevent or reduce the incidence of fires and explosions.

Areas identified as showing the most promise for future work are the following ongoing and potential research projects:

1) Suppression and venting research for galleries and tunnels;

2) A study of more effective hood designs for capturing dust emissions;

3) Evaluation of methods to measure and control dust concentrations inside equipment other than bucket elevators;

4) Research on spontaneous combustion or self-heating of grain;

5) Long-term studies on the use of smoke detection units in grain facilities;

6) Additional research to establish venting criteria for grain bins.

THE RESEARCH AND EDUCATION PROJECTS

The following is an update, by subject matter, of the research and education projects completed or underway.

CONFERENCES ON ELEVATOR DESIGN AND CONSTRUCTION

Elevator Design Conference: In September 1979, the Fire and Explosion Research Council conducted the first meeting of its kind to address comprehensively the many aspects of elevator design that affect safety. The conference focused on state-of-the-art design concepts and the practical options available to elevator operators when remodeling or expanding existing facilities or designing and building new elevators.

The conference resulted in a 500-page book, entitled A Practical Guide to Elevator Design. Included are discussions of bucket elevators, explosion venting and suppression, explosion monitoring devices, preventive maintenance, mechanical ignition sources, dust control, facility layout, structural design, the concept of high-speed elevators, and considerations

for upgrading existing facilities. This resource book (now out of print) has been used throughout the world as a source of practical information on elevator design.

Five Years of Progress -- Applying New Technology for Use in Elevator Operations, Engineering, Design and Safety: This was the theme of the second conference sponsored by the Fire and Explosion Research Council in September 1984. The meeting focused on how the Council's research results and recent innovations could be implemented within existing facilities. The program included addresses on facility layout, horizontal and vertical conveying, hazards monitoring, automation, and facility modernization.

Resulting from this second conference on elevator design is the publication entitled Retrofitting and Constructing Grain Elevators for Increased Productivity and Safety. The book is in use around the world, and has been translated into several languages. It is fast becoming the new reference book on grain elevator design and operation.

BUCKET ELEVATOR RESEARCH

The Fire and Explosion Research Council established as a high priority an examination of ways to control explosions that start in the bucket elevator, the most common source of primary explosions. Major projects involved:

Explosion Venting and Suppression of Bucket Elevators: A project conducted by Fenwal, Inc., Ashland, Massachusetts, showed

that explosion venting can be used effectively to protect bucket elevators from explosions. Testing was conducted in a 45-foot-high bucket elevator having a cross-sectional dimension of 2.2 by 1.2 feet. Ten vents were installed along the leg casing and in the head section. Separate venting ratios were determined for the head, boot, and leg sections. An average vent ratio of approximately five square feet of vent per 100 cubic feet of leg volume successfully protected the test elevator. The research also found that explosions could be suppressed effectively with an extinguishing agent (halon) before damaging explosive pressures could develop.

Testing of a Grain Distributor: A second research effort by Fenwal, Inc., demonstrated the effectiveness of a specially designed grain distributor--with a single spout opening--in limiting the spread of flames to other parts of a facility.

Fire Protection for Bucket Elevators: This project examined the feasibility of utilizing suppression systems to extinguish fires in bucket elevators. Conducted by Fenwal, Inc., the project examined methods to detect temperature changes within bucket elevators so that explosion suppression devices can be utilized to extinguish fires. The research found that fires could be readily detected using a two-stage detection system and that self-contained suppression devices could extinguish most fires.

Venting of Galleries: The Council has sponsored an investigation of the feasibility of venting galleries to minimize damage and reduce the spread of an explosion. The project, conducted by Factory Mutual Research Corp., Norwood, Massachusetts, tested both small-scale and full-size elongated structures. The full-scale structure was 8 feet high by 8 feet wide by 80 feet long. The project also investigated the amount of grain dust needed to fuel secondary explosions. As little as one-one hundredth of an inch was shown to be sufficient for flame propagation.

Suppression in Tunnels and Galleries: The Council considered research to determine if suppression systems could be effective in preventing the spread of explosions in galleries and tunnels. This preliminary effort, performed by Fenwal, Inc., and Factory Mutual Corp., was designed to provide initial data on halting the spread of an explosion in a tunnel or gallery. A single explosion test was run in the full-scale gallery to assess the feasibility of using halon suppression devices to stop or slow explosion propagation. Data from the test showed that timing and placement of suppression units were critical to successful explosion suppression.

GRAIN BIN VENTING

Venting of Grain Bins: A project conducted by the Christian Michelsen Institute, Bergen, Norway, examined the feasibility of venting grain bins. (Previous venting ratios adopted from research on small test chambers had indicated that venting was not a feasible means of protecting grain bins.) The research consisted of a series of explosion tests in which cornstarch was ignited in a bin approximately 65 feet high. Results indicate that bin tops may be able to be vented so that some explosions can be dissipated safely.

Bin Venting: Phase II: A second project to examine bin venting has been completed at the Christian Michelsen Institute. The project examined more closely the variables affecting the amount of explosion venting necessary to protect grain bins. A new 72-foot-high test bin was constructed which permitted testing at high explosive pressures. The project results show the effects that ignition source location, dust concentration, and vent area have on the pressures developed in grain bins.

Side Bin Venting: Using the test bin constructed in Phase II, the researchers at Christian Michelsen Institute tested the effectiveness of vents located on side walls of grain bins. The side vents were configured to simulate actual situations in most grain elevators, so that the amount of venting necessary to

protect against explosions could be estimated. The research results showed that under similar conditions, side venting resulted in lower pressures than vents on the bin roof.

COMBUSTIBLE GASES

Two projects have been completed to resolve the speculation over whether gases from fumigants or grain decomposition have the potential to contribute to the initiation or severity of an explosion.

Combustible Gases in Grain Elevators: Conducted by the Midwest Research Institute, Kansas City, Missouri, this project found that combustible gases and vapors do not emanate from decomposing or fumigated grain in amounts sufficient to contribute to the explosibility of grain dust. Concentrations of gases and vapors generally were less than 0.1 percent of the lower explosive limit. In addition, the project, which surveyed four elevators in different geographical regions at different times of the year, found that no detectable levels of gases were absorbed by the grain dust.

Concentrations of Gases Following Fumigation: Conducted by the Midwest Research Institute, this research determined that concentrations of phosphine and carbon disulfide used during the fumigation process do not accumulate to flammable levels. This research indicates that flammable fumigant levels are unlikely to

occur in grain-handling facilities, particularly if a minimal amount of air is circulated in confined portions of the facility, such as the tunnel.

ELECTROSTATICS

The fire and Explosion Research Council has sponsored nine projects on electrostatics--perhaps one of the most difficult subjects to research--to determine what concern static sparks warrant.

Electrostatic Charge Levels on Belt Conveyors: This research conducted by the University of Southampton, England, was a joint project of the Council and The Pillsbury Company. Measurements were taken during a wide range of ambient conditions. Measurements of electrostatic charges on conducting and non-conducting conveyor belting found that the charge levels at no time reached a hazardous level. Further, there was no relationship between the charge level on the belts and the ambient temperatures or relative humidity existing within the facility. The research also showed that static eliminators have limited usefulness.

Electrostatic Characteristics of Grain and Grain Dust: This research conducted by Safety Consulting Engineers, Inc., Rosemont, Illinois, discovered that although grain can accumulate amounts of electrostatic charges when moving across spouts and

chutes, such charges dissipate quickly when grain comes into contact with equipment or a structure that is well grounded. The research also found that moisture content of the grain has a significant effect upon its capacity to hold an electrical charge. Greater electrical charge accumulated on grain sliding over plastic-lined spouts than occurred when grain was moved across a steel spout.

Electrostatic Grounding Characteristics of Grain Facilities: A study conducted by Safety Consulting Engineers, Inc., Rosemont, Illinois, examined the electrostatic grounding characteristics of grain-handling facilities. The researcher measured the resistances and capacitances between equipment and earth ground to determine if the ungrounded equipment is a potential problem. Acceptable ranges for electrostatic ground resistance were established.

Ignitions Due to Electrostatics in Powder Systems: The Fire and Explosion Research Council was one of 15 companies and groups which participated in a 3-year study to examine electrostatic hazards that may occur in a full-scale bulk handling system. In the research, conducted by the University of Southampton, England, electrostatic charges that occur during handling of various bulk powders were measured including grain dust in a full-scale specially constructed handling system. The research

found it very difficult to establish hazardous levels of electrostatic charges when handling grain dust, even in the system designed to maximize static charge levels.

Static Electricity Field Strengths in Grain Bins: A project conducted by the University of Southampton, England, examined whether electrostatic charges accumulate in grain bins during filling and whether such charges are hazardous. The project measured the electrostatic field strengths within the bins of a Tilbury, England, grain terminal, which was selected because its design is similar to U.S. grain elevators. The research also measured the charge levels on grain as it falls into the bin. It was found that charge levels in the air space above the grain mass were the highest near the end of the bin filling process. However, at no time were the levels found to be hazardous.

Designing a Portable Belting Resistivity Measuring Device: This project conducted by Safety Consulting Engineers, Inc., designed a portable device that elevator operators could utilize to measure the resistivity of belting installed in grain-handling facilities. Prior to this project area, samples of the belting had to be submitted to laboratories for testing, or complex belt analyses had to be performed at the site to measure resistivity. A prototype model of the instrument was constructed and calibrated for field use by Dr. Allen Anway of Superior, Wisconsin, in a separate project.

Summary of Electrostatic and Metal Sparking Information: This project resulted in a publication which summarizes the Council's static electricity and metal sparking research into a format readily useable by engineers in the industry. The report was authored by Dr. Allen Anway of Superior, Wisconsin, and contains a description of static electricity theory as it applies to the grain industry.

METAL SPARKS

Four projects have examined the role metal sparks may play in grain dust explosions.

Survey of Literature of Ignition of Dusts by Friction and Impact Sparks: This project conducted by the University of Southampton, England, resulted in a compilation and review of information on the role of metal sparks as an explosion ignition source. The research concluded that available accident data are not statistically significant for fully addressing metal sparks as a grain dust ignition source. The survey found that high friction and continuous sparking incidents could be ignition sources in some cases, but indicated additional research information and data were needed before a complete evaluation could be made of whether sporadic or occasional sparking incidents are a hazard.

Effectiveness of Various Grating Sizes: This project conducted by Cargill, Inc., Minneapolis, Minnesota, examined various grating sizes to determine their effectiveness in removing foreign objects from the grain stream. A survey of industry firms also was conducted to determine grating sizes currently being utilized in the industry. Objects which may be found in the grain stream were placed into a hopper and released through a grate with grain. The efficiency of various grates in removing the objects was determined. Although smaller grate openings were more efficient, the research found that the grates also restricted grain flow for some grains.

Grain Dust Ignition by Friction Sparks: This preliminary laboratory study was conducted to determine what conditions were necessary for friction sparks to ignite a cloud of grain dust. The project was performed by Aerochem Research Laboratories, Inc., and it was found that, using a laboratory apparatus, friction sparks generated by steel in contact with a grinding wheel could consistently ignite clouds of grain dust with 10 percent moisture content. Factors affecting ignition were the number of sparks, dust concentration, steel carbon content, and spark size and velocity.

Single Impact Metal Sparks: A project conducted by the Christian Michelsen Institute, Bergen, Norway, examined the role

single-impact sparking incidents may play in initiating explosions. A device was constructed to cause two objects to strike each other during a single impact. Various steels and concretes were tested to determine if sparks from single impacts could ignite cornstarch. Results of the project suggest that sparks from single impacts of steel on steel and steel on concrete lack sufficient energy to ignite a grain dust cloud.

GRAIN DUST UTILIZATION

Two projects have been conducted on various ways grain dust can be or is being utilized, handled, or disposed of.

Literature Survey of Alternative Dust Uses: A literature study conducted by Kansas State University, Manhattan, Kansas, documented that at the time of publication only 23 research articles had been written on this subject. The report indicated that grain dust, when separated from grain and collected, is used primarily as a feed ingredient. The study also indicated that grain dust is being researched as a heat source (through burning), as a compost, as an agent for producing single-cell protein, and as a feed stock in the production of ethyl alcohol.

Current Utilization of Dust: A project conducted by The Andersons, Maumee, Ohio, found that grain dust that is separated and handled apart from grain is used most frequently as livestock

feed. The project surveyed 494 companies, including 335 grain elevators, 83 feed mills, 49 grain processors, 17 grain dust processors, and 10 grain dust users. The average percentage of grain dust collected by dust collection systems was 0.18 percent of the unit weight of grain handled. The survey found that much of the grain dust was retained in the grain or grain products.

ADDITIVES TO CONTROL GRAIN DUST

Examining the Use of Additives to Control Grain Dust: A joint project conducted for the Council by USDA's Grain Marketing Research Laboratory, Manhattan, Kansas, found that spray application of water and oil additives have potential merit as an option for controlling grain dust emissions during handling operations. The project found that application of water to corn reduced airborne grain dust emissions by at least 80 percent in the gallery area. Soybean oil and mineral oil reduced airborne grain dust by more than 90 percent in the gallery area. The research project was performed at an operating elevator facility in Ohio.

Efficacy of Oil Additives and Their Effect on Grain Quality: Under a joint project between the Fire and Explosion Research Council and the American Soybean Association, the Council evaluated the effectiveness of various oils and application techniques for controlling airborne dust. The project, performed

by the U.S. Department of Agriculture, considered the oils' effect on grain quality including angle of repose, grade levels, and milling characteristics. Oiled grain showed no adverse quality deterioration except for a consistent temporary reduction in test weight and the possibility of odor problems after repeated oil applications. An economic analysis of various dust control techniques was included.

PNEUMATIC CONTROL OF GRAIN DUST

Reducing Dust Concentrations by Prior Screening or Aspiration of Wheat: A project performed by Cargill, Inc's Grain Marketing Research Laboratory, Minneapolis, Minnesota, examined methods to reduce grain dust concentrations inside bucket elevators by removing dust from the grain before it was handled. The aspiration process reduced the airborne dust concentrations below the lower explosive limit. However, explosive dust levels often were generated the next time the grain was handled. This indicated that grain dust would have to be removed from grain prior to each handling to prevent explosive concentrations from developing in the bucket elevator.

Examining the Use of Pneumatic Dust Control to Prevent Explosible Dust Concentrations in Bucket Elevators: This project area is examining the control of airborne grain dust concentrations in bucket elevators utilizing pneumatic dust

collection systems. The first phase of the research effort entailed the construction of a device enabling calibration of several dust measurement instruments. The project was conducted by IIT Research Institute(IITRI), Chicago, Illinois (which is associated with the Illinois Institute of Technology). Conditions existing inside bucket elevators, including dust concentrations, air velocities, and turbulence, were examined for their effect on dust measurements.

Pneumatic Dust Control for Bucket Elevators: Phase II: This second phase of the research area, also conducted by IIT Research Institute, examined dust levels in operating bucket elevators. This phase confirmed the previous calibrations for the dust measurement devices within actual bucket elevators and evaluated their capabilities under actual elevator conditions. The project examined dust concentrations in bucket elevators equipped with pneumatic dust control for maintaining dust concentrations below the lower explosive limit.

Pneumatic Dust Control for Bucket Elevators: Phase III: The final phase of this project evaluated the effectiveness of various dust control systems in reducing dust concentrations in bucket elevators. The study resulted in development of a proposed dust collection inlet design for bucket elevators which would increase dust collection efficiency.

Calibration of a Grain Dust Concentration Measurement Device: This project analyzed the ability of a previously developed device to accurately measure airborne grain dust concentrations inside enclosed equipment. The project was performed by PPM, Inc., Knoxville, Tennessee, at the IITRI bucket elevator test site. The device was successfully calibrated and is reported on as part of the IITRI report on controlling dust concentrations with pneumatic dust control.

EXPLOSIVE CHARACTERISTICS OF GRAIN DUST

Two projects have been conducted to obtain better information on the explosive characteristics of grain dust. The research has been helpful in understanding and revising venting criteria and providing a better understanding of the grain dust explosion process.

Explosive Power of Grain Dust in a 20-Liter Chamber: This project performed by Kansas State University, Manhattan, Kansas, studied the explosive characteristics of grain dust in a 20-liter chamber. More reliable data was developed on the maximum rate of pressure rise and maximum pressures developed during an explosion. Variables which were studied that affect grain dust explosibility included: Particle size distribution, moisture content, and elemental and chemical composition.

Dust Hazard Index and Minimum Fuel: Texas A&M University, College Station, Texas, examined in a laboratory apparatus the amount of dust necessary for a secondary explosion to occur. The project also researched the minimum explosible concentrations and minimum ignition energies of various dusts.

SMOLDERING COMBUSTION

Examination of Smoldering Grain and Grain Dust: A study conducted by the University of Michigan, Ann Arbor, Michigan, examined various ways smoldering fires can start in grain facilities and measured the rates at which smoldering combustion can spread. The project examined the effect that air flow over the smoldering grain has on the grain breaking into flames.

SMOKE DETECTORS

Feasibility of Utilizing Smoke Detectors in Grain Facilities: This project performed by IIT Research Institute examined the feasibility of using several types of smoke detectors in various sections of grain elevators to provide an early alert system. Various smoke detectors were exposed to smoldering grain to determine response times, and detectors were studied in a preliminary field test of the varying conditions at a grain-handling facility.

BEARINGS

Analysis of Bearing Utilization in the Grain Industry: This project examined major load-carrying bearings within the grain industry to analyze areas where better information on bearing usage could be beneficial. Conducted by Mechanical Technology, Inc., Latham, New York, the project examined the location, installation and use of various types of bearings in an effort to determine where problems arise. The project suggested the need for better information on proper bearing selection, installation, and maintenance.

Bearing Handbook: Selection, Installation and Maintenance for the Grain Handling Industry: As a follow up effort to the earlier bearing research, the Council sponsored a project to develop a bearing manual for the grain industry. The project was performed by Mr. Robert Craig, a bearing consultant formerly with Mechanical Technology, Incorporated. The bearing manual presents helpful guidelines on how the industry can extend bearing life and reduce the chances for bearing failure through proper selection, installation, monitoring, and maintenance procedures.

EDUCATION AND INFORMATION

The Council's new emphasis on dissemination of safety information relating to fires and explosions in grain elevators has resulted in materials that elevator operators can use to train their own employees. The projects are:

Emergency Preplanning and Firefighting Manual: This publication was developed by the Education and Information Committee with input from professional firefighters. The guide contains information for elevator managers and employees on how to prepare for a fire-related emergency and how to react in the event of such an emergency, and guidelines on how to fight fires in grain elevators. The manual also contains information on elevator operation and emergency preparedness for firefighting personnel.

Council Publication Donations: This project began an information exchange with universities, affiliated associations, and other groups by donating a number of the Council's publications. Over 700 research reports, conference proceedings, and information brochures were distributed.

Commitment to Safety: This videotape program was developed to summarize the formation of the Council and its function, and to give some of the major research findings. The program was distributed to all of the national's affiliate associations and copies have been donated to government and members of Congress, as well as libraries and universities across the country.

Partners for Protection: This videotape was developed based on the previously released firefighting manual. The program is

suitable for training of both elevator employees and firefighters.

Flammability/Ignition Characteristics of Grain Elevator Conveyor Belts and Plastic Materials: This brochure is being developed to provide elevator operators information on tests, ratings, and specifications used by belt and plastic manufacturers relating to flammability. The characteristics investigated include flame spread, electrical resistivity, oil resistance, and fire retardance. It should help elevator operators make informed decisions when specifying new materials.

Council Scholarship Fund: This $15,000 fund was created to award scholarships to deserving agriculture or engineering students actively involved in fire and explosion research. The annual interest from the fund will be awarded each September 1 beginning in 1990 based on a recommendation from a three-member panel made up of Council representatives.

Fire and Explosion Control Systems: Design and Implementation: This videotape examines methods used to detect or monitor for potentially hazardous conditions in grain-handling facilities, ways to control and extinguish fires should they occur, methods for suppressing explosions, and systems for venting the pressure from explosive forces in order to minimize damage. (Estimated completion September 1989)

Fuel for Thought: Controlling Fuel Sources in Grain Elevators: This videotape discusses one of the three elements necessary for a dust explosion to occur fuel. The program examines the potential for grain dust to fuel fires and explosions and other fuel sources in grain-handling facilities. Ways to control dust are presented. (Estimated completion December 1989)

No Chance Here: Controlling Ignition Sources in Grain Elevators: This videotape also presents one of the elements necessary for a fire to occur an ignition source. It examines some of the more common ignition sources such as welding or cutting, friction, mechanical sparks, electrical equipment, grain dryers, smoldering grain, and smoking. The video also discusses ways to avoid potential ignition sources. (Estimated completion December 1989)

Brochures Series: This series of brochures was designed for elevator managers to help manage their elevators with an eye toward safety by providing them with the latest information on fire and explosion issues and prevention techniques. The brochures present in layman's terms research results which, if implemented, can enhance the safety of grain-handling operations.

Exhibit D

Program of the
Grain Industry Safety and Health Center

A Service of the
Grain Elevator and Processing Society

Specialists in a wide range of grain operations issues, the Grain Elevator and Processing Society (GEAPS) offers an extensive array of resources to the grain handling and processing industry.

Significant among them is the GEAPS Grain Industry Safety and Health Center (GISHC), which provides safety and health training materials tailored to helping grain operations professionals keep their employees and facilities safe. Programs address fire and explosion hazards, operational hazards, emergency action planning, loss prevention, chemical hazards, transportation hazards, and contractor safety. (See list of available programs.)

The largest gathering of its kind, "GEAPS Exchange" is the grain handling and processing industry's annual opportunity to assemble hundreds of operations professionals and technical experts. The 3-day educational program explores topics ranging from "nuts and bolts" to facility management. Special emphasis is placed on achieving the optimal combination of operations efficiency and safety and health assurance.

The Exchange Expo assembles an exhibit hall full of products, equipment, and services for grain operations. Attendees have the unique opportunity of exploring state-of-the-art technology along with the tried and true tools of their business.

Other services provided by GEAPS to the grain handling and processing industry include:

-- Networking Opportunities. A system of 35 chapters stretching across North America provides monthly meeting opportunities for thousands of grain operations professionals. Technical presentations and peer contact encourge attendees to tune in to industry developments.

-- Publications. GEAPS produces a 12-page monthly newsletter, "In-Grain," which is the industry's source for grain operations expertise. Articles on safety and health developments, grades and weights issues, government regulation, and operations efficiency guarantee that readers are kept up-to-date on their industry. The annual "GEAPS DirectaSource" is a resource guide for grain operations, including sections on industry associations and regulatory agencies, along with GEAPS member listings and the most extensive "buyers' guide" in the industry.

GISHC Safety and Health Training Programs

Guidebooks

. Contractor Safety Orientation

. County Elevator Safety and Health

. Chemical Hazard Communication

. Emergency Action Planning

. Loss Prevention/Safety and Health

Video/Slide-Tape Programs

- Loss Prevention/Safety and Health
  - Common Hazards/Common Sense
- Preventing Grain Dust Explosions
  - An Introduction
  - Controlling the Ignition Sources
  - Controlling the Fuel Sources
- Occupational Health
  - Hazard Recognition
  - Respiratory Protection - Breathing Easier
- Operations/Maintenance Safety
  - An Introduction
  - Safe Bin and Tank Entry
  - Lock-Out and Tag
  - Electrical Hazard Awareness
  - Walkways and Work Surfaces
  - Bucket Elevators
- Transportation Safety
  - Truck and Rail Handling

Poster Series

- Preventing Grain Dust Explosions
- Operations/Maintenance Safety

Audio Cassettes

- Grain Dust - Fires and Explosions
- Risk Takers
- Rules and Procedures Make the News